Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

UNDERGROUND CABLE FAULT DISTANCE LOCATOR USING GSM

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ABSTRACT:- *This paper presents an idea of fault locating method with highly computational method. The project also presents some guidelines for design of fault location and remote indication, for reducing power outages and reducing heavy loss of revenue. The paper proposes fault location model for underground power cable using microcontroller. The aim of this paper is to determine the distance of underground cable fault from base station in meters. This paper uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in a cable, as the current varies. A set of resistors are therefore used to represent the cable and a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using a analog to digital converter and a microcontroller is used to make the necessary calculations so that the fault distance is calculated and will be displayed in the LCD display. In addition a message in the form of SMS about the fault location will be sent to the concern person mobile through the GSM modem which is also interfaced to the controller.*

Keywords---- *Microcontroller, GSM, LCD, ADC, Resistors*

I.INTRODUCTION

Till last decades cables were made to lay overhead and currently it is lay to underground cable which is superior to earlier method. Because the underground cable are not affected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution. But when any fault occur in cable, then it is difficult to locate fault. So we will move to find the exact location of fault. Now the world is become digitalized so the project is intended to detect the location of fault in digital way. The underground cable system is more common practice followed in many urban areas. While fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of cable fault.

Underground power cables have been widely implemented due to reliability and environmental concerns. To improve the reliability of a distribution system, accurate identification of a faulted segment is required in order to reduce the interruption time during fault, i.e. to restore services by determining a faulted segment in a timely manner. In the conventional way of detecting fault, an exhaustive search in larger scale distance has been conducted. This is time consuming and inefficient. Not only that, the manpower resources are not utilized, but also the restoration time may vary depending on the reliability of the outage information. As such deriving an efficient technique to locate a fault can improve system reliability.

II. LITERATURE REVIEW

Till last decades cables were made to lay overhead& currently it is lay to underground cable which is superior to earlier method. Because the underground cable are not affected by any adverse weather condition such as strom, snow ,heavy rainfall as well as pollution.But when any fault occur in cable, then it is difficult to locate fault. The most common types of fault that occur in underground cables are:

1. Open circuit fault.
2. Short circuit fault.
3. Earth fault.

1. Open circuit fault

When there is a break in the conductor of a cable, it is called open-circuit fault. The open-circuit fault can check by a megger. For this purpose, the three conductors of the 3 core cable at far end are shorted and earthed. Then resistance between each conductors and earth is measured by a megger. The megger will indicate zero resistance in the circuit of the conductor that is not broken. However if a conductor is broken the megger will indicate an infinite resistance.

2. Short-circuit fault

When two conductors of a multi core cable come in electrical contact with each other due to insulation failure, it is so called as short-circuit fault. Megger can also be used to check this fault. For this the two terminals of a megger are connected to any two conductors. If the megger gives a zero reading it indicates short-circuit fault between these conductors. The same is repeated for other conductors taking two at a time.

3. Earth fault

When the conductor of a cable comes in contact with earth, it is called earth fault or ground fault. To identify this fault, one terminal of the megger is connected to the conductor and the other terminal connected to the earth. If the megger indicates zero reading, it means the conductor is earthed. The same procedure is repeated for other conductors of the cable.

Finding the location of an underground cable fault doesn't have to be like finding a needle in a haystack. The common methods of locating faults are

1. Sectionalizing: This procedure risks reducing cable reliability, because it depends on physically cutting and splicing the cable. Dividing the cable into successively smaller sections and measuring both ways with an ohmmeter or high-voltage insulation resistance (IR) tester enable to narrow down search for a fault. This laborious procedure normally involves repeated cable excavation.

2. Time domain reflectometry (TDR): The TDR sends a low-energy signal through the cable, causing no insulation degradation. A theoretically perfect cable returns that signal in a known time and in a known profile. Impedance variations in a "real-world" cable alter both the time and profile, which the TDR screen or printout graphically represents. One weakness of TDR is that it does not pinpoint faults.

3.Murray loop test: It It is a bridge circuit used for locating faults in underground or underwater cables. It uses the principle used in potentiometer experiment. One end of the faulted cable is connected through a pair of resistors to the voltage source. Also a null detector is connected. The other end of the cable is shorted. The bridge is brought to balance by changing the value of RB.

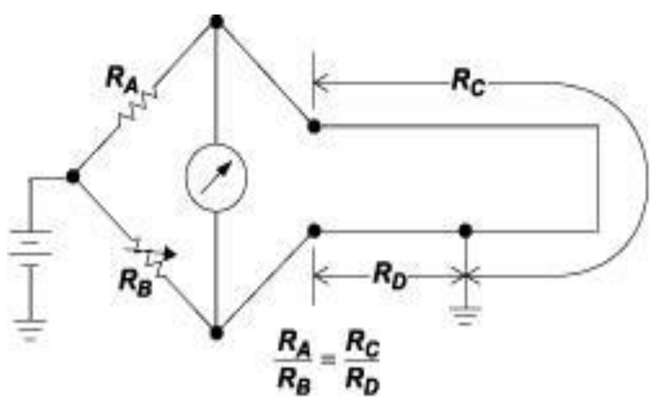

Figure 1 :Murray loop test

RA/RB=r=RC/RD = (2l-x)/x (1)
And hence
x= 2l/(r-1) (2)
Where l is the length on each segment of wire, r is the ratio RA/RB and x is the length of faulty segment.
The main disadvantage of this method assumes that only a single fault exists, a low resistance when compared with UG cable resistance and cable conductor have uniform resistance per unit length.

4.Varley loop test: If the fault resistance is high , the sensitivity in Murray bridge is reduced and Varelyoop may be more suitable but only a single fault exists. Except that here the ratio arms are fixed and a variable resistance is connected to the test end of the faulty cable. The drawbacks of the above methods can be overcome to certain extent by this method in which the concept of **OHM's law is applied**

III .CIRCUIT DESIGN AND IMPLEMENTATION

In this project simple OHM's law is used to locate the short circuit fault. A DC voltage is applied at the feeder end through a series resistor, depending upon the length of fault of the cable current varies. The voltage drop across the series resistor changes accordingly, this voltage drop is used in determination of fault location

Algorithm:

Step1: Initialize the ports, declare timer, ADC, LCD functions.

Step2: Begin an infinite loop; turn on relay 1 by making pin 0.0 high.

Step3: Display "R:" at the starting of first line in LCD.

Step4: Call ADC Function, depending upon ADC output, displays the fault position.

Step5: Call delay.

Step6: Repeat steps 3 to 5 for other two phases.

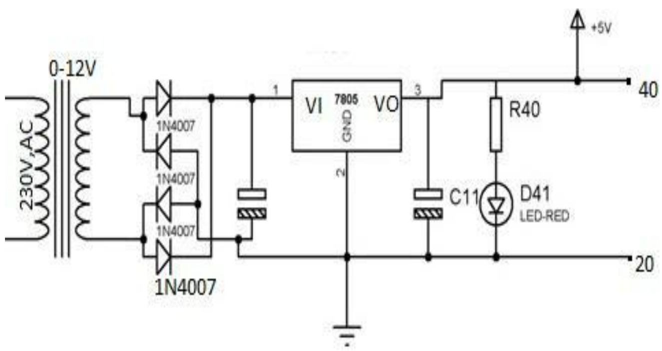

Figure 2: Power supply

Power Supply: The circuit uses standard power supply comprising of a step-down transformer from 230Vto 12V and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470µF to 1000µF. The filtered dc being unregulated, IC LM7805 is used to get 5V DC constant at its pin no 3 irrespective of input DC varying from 7V to 15V. The input dc shall be varying in the event of input ac at 230volts section varies from 160V to 270V in the ratio of the transformer primary voltage V1 to secondary voltage V2 governed by the formula V1/V2=N1/N2. As N1/N2 i.e. no. of turns in the primary to the no. of turns in the secondary remains unchanged V2 is directly proportional to V1.Thus if the transformer delivers 12V at 220V input it will give 8.72V at 160V.Similarly at 270V it will give 14.72V.Thus the dc voltage at the input of the regulator changes from about 8V to 15V because of A.Cvoltage variation from 160V to 270V the regulator output will remain constant at 5V.

The regulated 5V DC is further filtered by a small electrolytic capacitor of 10µF for any noise so generated by the circuit. One LED is connected of this 5V point in series with a current limiting resistor of 330Ω to the ground i.e., negative voltage to indicate 5V power supply availability. The unregulated 12V point is used for other applications as and when required.

2. Reset: Pin no 9 is provided with a re-set arrangement by a combination of an electrolytic capacitor and a register forming RC time constant. At the time of switch on, the capacitor gets charged, and it behaves as a full short circuit from the positive to the pin number 9. After the capacitor gets fully charged the current stops flowing and pin number 9 goes low which is pulled down by a 10k resistor to the ground. This arrangement of reset at pin 9 going high initially and then to logic 0 i.e., low helps the program execution to start from the beginning. In absence of this the program execution could have taken place arbitrarily anywhere from the program cycle. A pushbutton switch is connected across the capacitor so that at any given time as desired it can be pressed such that it discharges the capacitor and while released the capacitor starts charging again and then pin number 9 goes to high and then back to low, to enable the program execution from the beginning. This operation of high to low of the reset pin takes place in fraction of a second as decided by the time constant R and C.

For example: A 10µF capacitor and a 10kΩ resistor would render a 100ms time to pin number 9 from logic high to low, there after the pin number 9 remains low.

External access (EA): Pin no 31 of 40 pin 8051 microcontroller termed as EA¯ is required to be connected to 5V for accessing the program form the on-chip program memory. If it is connected to ground then the controller accesses the program from external memory. However in this project internal memory it is always connected to +5v

ULN 2003 relay driver IC: ULN2003 is an IC which is used to interface relay with the microcontroller since the output of the micro controller is maximum 5V with too little current delivery and is not practicable to operate a relay with that voltage. ULN2003 is a relay driver IC consisting of a set of Darlington transistors. If logic high is given to the IC as input then its output will be logic low but not the vice versa. Here in ULN2003 pins 1 to 7 are IC inputs and 10 to 16 are IC outputs. If logic 1 is given to its pin no 1 the corresponding pin 16 goes low. If a relay coil is connected from positive to the output pin of the uln2003, (the relay driver) then the relay contacts change their position from normally open to close the circuit as shown in the fig.4. Thus , this relay plays an important role in the design of circuit for underground cable fault detection.

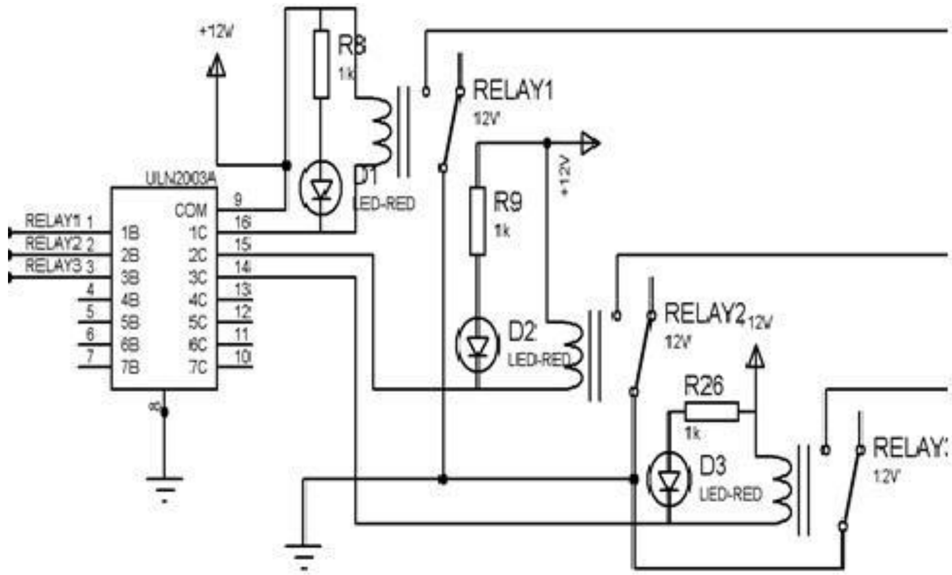

Figure 3: Relay Driver and Relay

1. **Connections:** The output of the power supply which is5v is given to the 40rth pin of microcontroller and GND is connected to its 20th pin. Port 1.0 to 1.3 of microcontroller is given to 18 to 15 pin of ADC0804. Relay's 1, 2, &3 are given to pins 1B, 2B&3B of ULN2003A and port0.0 to 0.2 of microcontroller. Port 3.0 to 3.5 of microcontroller are given to pin 2,3,5 of ADC0804. Pin's 16,15,14 of ULN2003A are given to relay's RL1,RL2,RL3 which drives set of resistor's (R17, R16, R15, R14), (R21,R20,R19,R18) and (R25, R24, R23, R22).

Working: The project uses four sets of resistances in series representing cables i.e. R10,R11,R12,R13 and R17,R16,R15,R14,then R21, R20,R19,R18, then R24,R23 R22 as shown in the circuit diagram, one set for each phase. Each series resistors represents the resistance of the underground cable for a specific distance thus 4 such resistances in series represent 1-4kms. 3 relays are used to common point of their contacts are grounded while the NO points are connected to the input of the R17, R21 & R25 being the 3 phase cable input. R10 is fed with a series resistor R1 to 5v supply.

1. Operating procedure

The project uses the simple concept of OHMs law where a low DC voltage is applied at the feeder end through a series resistor. The current would vary depending upon the length of fault of the cable in case there is a short circuit. The series resistor voltage drop changes accordingly which is then fed to an ADC to develop precise digital data which the programmed microcontroller would display the same in meters and also transmits the information through GSM. The project is assembled with a set of resistors representing cable length in meters and fault creation is made by a set of switches at every known distance to cross check the accuracy of the same. The underground cable fault distance is measured by using a simple technique of potential divider network. A fixed resistor (R1) is connected to the cable (R2) that is to find the distance where the fault occurred. And the cable (R2) starting point is connected to the ADC to read the voltage variation depending on the resistance variation of the cable. This is nothing but connecting of a potential divider network with the fault cable to distinguish the fault distance. Underground cables vary widely, but typically underground cable outage rates are about half of their equivalent overhead line types. Potentially far fewer momentary interruptions occur from lightning, animals and tree branches falling on wires which de-energize a circuit and then re-energize it a moment later. Primary benefits most often cited can be divided into four areas:

Potentially-Reduced Maintenance and Operating Costs:

Lower storm restoration cost

Lower tree-trimming cost

Increased reliability during severe weather (wind-related storm damage will be greatly reduced for an underground system, and areas not subjected to flooding and storm surges experience minimal damage and interruption of electric service. Less damage during severe weather Far fewer momentary interruptions Improved utility relations regarding tree trimming Fewer motor vehicle accidents Reduced live-wire contact injuries Fewer Fires Improved aesthetics (removal of unsightly poles and wires, enhanced tree canopies).

V.CONCLUSION

The project work Titled **"**UNDERGROUND CABLE FAULT DISTANCE LOCATOR USING GSM**"** is successfully designed & developed, and a demo unit is fabricated and the results are found to be satisfactory. In this project we detect the exact location of short circuit fault in the underground cable from feeder end in km by using microcontroller 89C052. For this we use simple concept of OHM's law so fault can be easily detected and repaired. In this project we detect only the location of short circuit fault in underground cable line, but we also detect the location of open circuit fault, to detect the open circuit fault capacitor is used in ac circuit which measure the change in impedance & calculate the distance of the fault. In the present project preference is not given for the compactness in the system, there by the controller selected here is not having built in ADC, so an external one is used. But for real time applications in built ADC controllers like pic can be selected, which avoids external devices like multiple channels ADC and clock signal generator. As the ADC chip used here is having eight channels, seven more inputs can be considered and their values can be displayed and transmitted.

VI.FUTURE SCOPE

In this project we detect not only the location of short circuit fault in underground cable line, but also detect the location of open fault. To detect the open circuit fault, capacitor can be used in ac circuit to measure the change in impedance & calculate the distance of fault. This prototype is a basic model for underground cable fault detection which can be helpful in future for fault detection and correction purpose.

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